Estimates and Projections Area Documentation

**State and County Total Population Estimates**

**BACKGROUND**

The U.S. Census Bureau annually produces estimates of total resident population for each state and county. County population estimates are produced with a component of population change method, while the state population estimates are solely the sum of the county populations. The following documentation describes the work that was carried out to produce the July 1, 2004 total resident population estimates at the county level.

**OVERVIEW**

The Census Bureau develops county population estimates with a demographic procedure called an "administrative records component of population change" method. A major assumption underlying this approach is that the components of population change are closely approximated by administrative data in a demographic change model. In order to apply the model, Census Bureau demographers estimate each component of population change separately. For the population residing in households the components of population change are births, deaths, and net migration, including net international migration. For the non-household population, change is represented by the net change in the population living in group quarters facilities.

Each component in our model is represented with data that are symptomatic of some aspect of population change. For example, birth certificates are symptomatic of additions to the population resulting from births, so we use these data to estimate the birth component for a county. Some other components are derived from death certificates, Internal Revenue Service data (IRS), Medicare enrollment records, Armed Forces data, group quarters population data, and data from the American Community Survey (ACS).

In cases where we do not have data for all counties for the current estimate year, we estimate the components of population change based on one or more simplifying assumptions.  When we prepare our initial population estimates, we use the same variant of the component model with these simplifying assumptions. In the creation of current vintage population estimates, we replace the initial population estimates from the previous vintage with "revised" population estimates calculated with the actual data for all components of population change. Calculations of "revised" population estimates also incorporate updates to components of change from previous years.

**METHOD**

We produce the estimates of the county populations, starting with the base populations from either Census 2000 or the revised population estimate for the most recent year and then add or subtract the demographic components of population change calculated for the time period. Basically, we add the estimated number of births and subtract the estimated number of deaths for the time period. We then account for net migration, which is

calculated using several components including net internal migration, net foreign-born international migration, net movement to/from Puerto Rico, net Armed Forces movement to/from overseas, the change in group quarters population, and native emigration from the United States.

We produce separate population estimates for the populations under age 65 and age 65 and older, mainly because different data are used to measure the internal migration of these two populations. For the population under age 65, we use data from individual IRS tax returns to calculate measures of migration.

We use Medicare enrollment to calculate measures of migration for the population age 65 and older because this population is not always well-represented on tax returns.

The following describes how we produce population estimates for these two populations.

**STEP 1: ESTIMATING THE POPULATION UNDER AGE 65**

- **1A. Base Populations**

  **1A-1. Total base population under age 65 -** The total base population for the estimate of the population under age 65 is either the April 1, 2000 population estimates base or the revised county population estimate for the prior estimate year. For official population estimates, the April 1, 2000 population estimates base is not adjusted for census undercount.

  In general, the April 1, 2000 population estimates base uses Census 2000 data as its base, but includes certain modifications (geographic updates, Count Question Resolution (CQR changes) to the Census Bureau's program TIGER database).

  **1A-2. Base group quarters population under age 65 -** The group quarters population component is primarily a combination of military personnel living in barracks, college students living in dormitories and persons residing in institutions. Inmates of correctional facilities, persons in health care facilities and persons in Job Corps Centers are also included in this category. We have excluded persons age 65 and older residing in nursing homes and other facilities from this category since they are included in the estimate of the population age 65 and older. The base group quarters population for the current estimate year is the revised group quarters population from the prior estimate year. In the first estimate year following the decennial census, the base group quarters population is the group quarters population as enumerated in Census 2000.

  **1A-3. Base household population under age 65 -** After we subtract the base group quarters population under age 65 from the base total population under age 65 we have a residual that we call the base household population under age 65 by county. The general formula is as follows:

  $U65HP_{x-1} = AREST_{x-1} - (EX64_{x-1} + EPO65_{x-1} + GQ{<}65_{x-1})$

Where:

U65HP    is the county base household population under age 65

AREST    is the total county population for all ages

EPO65    is the county population age 65 and older

GQ<65    is the county group quarters population under age 65

EX64     is the county population age 64 in the previous estimate year (who will turn age 65 in the current estimate year).

Note: In the above formulas -

x-1      denotes the previous estimate year

**1A-4. Population base of potential internal migrants under age 65 -** The population base of potential internal migrants is defined as the midpoint population of the period since the population at the beginning of the estimate period has not yet experienced the births and deaths that are reflected in the population at the end of the period. Also, the population at the end of the estimate period includes in-migrants and excludes out-migrants. The best compromise is to take the population at the midpoint of the period.

We assume that estimated resident births, estimated deaths to people under age 65, and net international migration are evenly distributed throughout the estimate interval.  Therefore, they have the potential for migration, on average, for one-half of the period. We develop the internal migration base under age 65 by adding one half of the following to the previous year's household base population under 65 years: estimated resident births minus estimated resident deaths under 65 years, plus estimated net international migration. The base internal migration population under age 65 is calculated using the following formula:

$$\text{MBASE<65}_x = \text{U65HP}_{x-1} + (.5 * (\text{PB}_x - \text{PD<65}_x + \text{FBINAT<65}_x - \text{EMIG<65}_x + \text{NMPR<65}_x))$$

Where:

MBASE<65    is the county population base of potential internal migrants under age 65

U65HP       is the county base household population under age 65

PB          is the county-level period births

PD<65       is the county-level period deaths to the population under age 65

FBINAT<65   is the county net foreign-born international migration of the population under age 65

EMIG<65     is the county native emigration of the population under age 65

NMPR<65     is the county net movement to/from Puerto Rico under age 65

Note: In the above formula -

x               denotes the current estimate year

x-1          denotes the previous estimate year

- **1B. Components of population change**

**1B-1. Resident births -** Resident births are recorded by residence of mother, regardless of where the birth occurred; hence, a county need not have a hospital in order to have resident births.

**1B-2. Resident deaths to population under age 65 -** We use death data tabulated by the most recent residence of the decedent, not by the place where the death occurred.

**1B-3. Net internal migration for population under age 65 -** We estimate the net internal migration within the United States during the estimate interval. Our estimate includes household migration derived from Federal income tax returns and the change in the group quarters population.

> **1B-3a. Migration from Federal Income Tax Returns -** We use data from Federal income tax returns supplied by the Internal Revenue Service (IRS) to measure part of the internal migration of the population under age 65. These data are limited to filers and their exemptions who are under age 65. We derive net internal migration rates using these data and then apply these rates to the household population under age 65.
>
> **Part 1. Internal Migration Rate -** The net internal migration rate for the household population under age 65 for each county is calculated using the following formula, which is based on the difference between the in-migration and out-migration of tax filers and their dependents:
>
> $NiMR{<}65_x = [(INST_x + INCTY_x) - (OUTST_x + OUTCTY_x)] / (NON_x + OUTST_x + OUTCTY_x)$
>
> Where:
>
> NiMR<65   is the county net internal migration rate for the household population under age 65

INST        is the county in-migrants from another state

INCTY       is the county in-migrants from another county within the
            same state

OUTST       is the county out-migrants to another state

OUTCTY   is the county out-migrants to another county within the
            same state

NON         is the county nonmigrants

**Part 2. Net internal migration -** Net migration for the population
under age 65 is the product of the net internal migration rate
(NiMR<65) and the base internal migration population under age
65, as calculated using the following formula:

$$MIG{<}65_x = (MBASE{<}65_x * NiMR{<}65_x) - AF{<}65_x$$

Where:

MIG<65        is the county net internal migration of the household
              population under age 65

MBASE<65   is the county population base of potential internal
              migrants under age 65

NiMR<65      is the county net internal migration rate for the
              household population under age 65

$AF{<}65_x$        is the county net Armed Forces movement to/from
              overseas under age 65

**1B-3b. Migration from Change in Group quarters Population -**
We use data on the change in the group quarters population to
measure part of the internal migration of the population under age
65. We use group quarters population data from two sources to
estimate county populations: (1) Census 2000 counts of group
quarters population by single year of age and facility type for each
subcounty area, and (2) a time series of individual group quarters
records from the Group quarters Report (GQR). Subcounty areas
are commonly referred to as places, cities, towns, etc. These areas
represent functioning governmental units and residual pieces
thereof.

These two sets of group quarters population data are used to derive a time series of group quarters population through the following process:

**Part 1.** We sum the group quarters populations from Census 2000 (total under age 65 only) and the GQR to the subcounty level by the seven facility types for each estimate date in the time series.

**Part 2.** We derive the total group quarters population under age 65 by GQ type from the summarized GQR data using age distribution data from Census 2000 in the following formula:

$$GQR{<}65_{x,t} = (GQ{<}65_{C2000,t} / GQ_{C2000,t}) * GQRTOT_{x,t}$$

Where:

GQR<65    is the subcounty GQR population under age 65

GQ<65    is the subcounty group quarters population under age 65

GQ        is the subcounty group quarters population of all ages

GQRTOT   is the subcounty GQR population of all ages

**Part 3.** We assume no change in the group quarters population between April 1, 2000 and July 1, 2000. The time series of subcounty group quarters population under age 65 by GQ type from July 1, 2000 to July 1, 2004 is then calculated by adding the year to year change given by the GQR data, using the following formula:

$$GQ{<}65_{x,t} = GQ{<}65_{x-1,t} + (GQR{<}65_{x,t} - GQR{<}65_{x-1,t})$$

Where:

GQR<65    is the subcounty GQR population under age 65

GQ<65    is the subcounty group quarters population under age 65

**Part 4.** The subcounty numbers are summed to the county level for the calculation of county population estimates.

Note: In the above formulas-

C2000  denotes a Census 2000 reference date

x       denotes the current estimate year

x-1     denotes the previous estimate year

t       denotes facility type (correctional institutions, juvenile facilities, nursing homes, other institutional, university dormitories, military barracks, other noninstitutional)

**1B-4. Net international migration for population under age 65 -** We estimate the net international migration to/from the United States from several sources. Our estimate includes the net foreign-born international migration, net movement to/from Puerto Rico, net Armed Forces movement to/from overseas, and native emigration.

**1B-4a. Net foreign-born international migration -** National-level data on the net foreign-born international migration of the population under age 65 for the current estimate period are distributed to counties based on the county distribution of the non-citizen foreign-born population who entered the U.S. during the 5 years prior to April 1, 2000 from Census 2000 using the following formula:

$$\text{FBINAT}{<}65_{NAT,x} = \text{NFBINAT}{<}65_{NAT,x} * (\text{FB}{<}65_{NAT,C2000} / \text{NFB}{<}65_{NAT,C2000})$$

Where:

FBINAT<65    is the county net foreign-born international migration under age 65

NFBINAT<65  is the national net foreign-born international migration under age 65

FB<65         is the county non-citizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000

NFB<65       is the national non-citizen foreign-born population under age 65 who entered the U.S. during the five years prior to April 1, 2000

**1B-4b. Net movement from Puerto Rico -** National-level data on the total net movement of the population under age 65 to or from Puerto Rico for the current estimate period are distributed to counties based on the county distribution of the Puerto Rican population who entered the U.S. during the five years prior to April 1, 2000 from Census 2000 using the following formula:

$$NMPR{<}65_x = NATNMPR{<}65_x * (PR{<}65_{C2000} / NATPR{<}65_{C2000})$$

Where:

| | |
|---|---|
| NMPR<65 | is the county net movement to/from Puerto Rico under age 65 |
| NATNMPR<65 | is the national net movement to/from Puerto Rico under age 65 |
| PR<65 | is the county population under age 65 born in Puerto Rico who entered the U.S. during the five years prior to April 1, 2000 |
| NATPR<65 | is the national population under age 65 born in Puerto Rico who entered the U.S. during the five years prior to April 1, 2000 |

**1B-4c. Armed Forces movement to/from overseas -** County-level data on net overseas movement of Armed Forces under age 65 for the current estimate period are derived using a three-stage process. First, the national-level total Armed Forces station strength data are distributed to states using Armed Forces data originally supplied by each branch of the service. Second, these state-level data are distributed to counties using the military employment data from Census 2000. Raking occurs at the final step to control county-level data to national-level data.

**1B-4d. Native emigration from the United States -** National-level data on the total number of emigrants from the United States under age 65 for the current estimate period are distributed to counties based on the county distribution of the native-born population from Census 2000 using the following formula:

$$EMIG{<}65_x = NATEMIG{<}65_x * (NATIVE{<}65_{C2000} / NATNATIVE{<}65_{C2000})$$

Where:

| | |
|---|---|
| EMIG<65 | is the county native emigration of the population under age 65 |
| NATEMIG<65 | is the national native emigration of the population under age 65 |
| NATIVE<65 | is the county native-born population under age 65 |
| NATNATIVE<65 | is the national native-born population under age 65 |

Note: In the above formulas -

| C2000 | denotes a Census 2000 reference date |
| X | denotes estimate year |

- **1C. Calculating the Population Under Age 65**

The formula for estimating the county population under age 65 from the base populations and the components of population change is as follows:

$$U65_x = U65HP_{x-1} + PB_x - PD{<}65_x + MIG{<}65_x + GQ{<}65 + FBINAT{<}65_x - EMIG{<}65_x + NMPR{<}65_x + AF{<}65_x$$

Where:

| U65 | is the total county population under age 65 |
| U65HP | is the county base household population under age 65 |
| PB | is the county-level period births |
| PD<65 | is the county-level period deaths to the population under age 65 |
| MIG<65 | is the county net internal migration of the household population under age 65 |
| GQ<65 | is the county group quarters population under age 65 |
| FBINAT<65 | is the county net foreign-born international migration of the population under age 65 |
| EMIG<65 | is the county native emigration of the population under age 65 |
| NMPR<65 | is the county net movement to/from Puerto Rico under age 65 |
| AF<65 | is the county net Armed Forces movement to/from overseas under age 65 |

Note: In the above formula -

| x | denotes the current estimate year |
| x-1 | denotes the previous estimate year |

Note: All components of population change are rounded to the nearest whole number. Where applicable, the differences between the sum of rounded components and the independently produced national components are added to or subtracted from the components for Los Angeles County, California (county with the greatest population in the United States).

**STEP 2: ESTIMATING THE POPULATION AGE 65 AND OLDER**

- **2A. Base Populations**

**2A-1. Base total population age 65 and older -** The total base population for the estimate of the population age 65 and older is either the Census 2000 base (for July 1 population estimate in the decennial year) or the revised county population estimate for the prior estimate year. See section 1A-1 for a summary of the changes to the Census 2000 base population.

**2A-2. Base group quarters population age 65 and older -** This component is primarily a combination of persons age 65 and older residing in nursing homes and other facilities and persons residing in institutions. Inmates of correctional facilities, persons in health care facilities, and Armed Forces living in barracks are all included in this category. The base group quarters population for the current estimate year is the revised group quarters population from the prior estimate year. In the first estimate year following the decennial census, the base group quarters population is the group quarters population as enumerated in Census 2000.

**2A-3. Base household population age 65 and older -** After we subtract the base group quarters population age 65 and older from the base total population age 65 and older, we have a residual that we call the base household population age 65 and older. The basic formula is as follows:

$$O65HP_{x-1} = EPO65_{x-1} + EX64_{x-1} - GQ65+_{x-1}$$

Where:

O65HP   is the county base household population age 65 and older

EPO65   is the county population age 65 and older

EX64     is the county population age 64 in the previous estimate year (who will turn age 65 in the current estimate year).

GQ65+   is the group quarters population age 65 and older

In the above formula -

x-1      denotes the previous estimate year

**2A-4. Population base of potential internal migrants age 65 and older –** The process we use to derive the population base of potential internal migrants age 65 and older is similar to that used for the under 65 population with the following modifications. Net migration of foreign born is excluded from the migration base because we assume they are not eligible for Medicare. See section 1A-4 for a more detailed description. The basic formula is as follows:

$$\text{OBASE65+}_x = \text{O65HP}_{x-1} + (.5 * (\text{AF65+}_x - \text{PD65+}_x - \text{EMIG65+}_x + \text{NMPR65+}_x)$$

Where:

OBASE65+ is the county population base of potential internal migrants age 65 and older

O65HP is the county base household population age 65 and older

AF65+ is the county net Armed Forces movement to/from overseas age 65 and older

PD65+ is the county-level period deaths to the population age 65 and older

EMIG65+ is the county native emigration of the population age 65 and older

NMPR65+ is the county net movement to/from Puerto Rico age 65 and older

Note: In the above formula -

$x$ denotes the current estimate year

$x-1$ denotes the previous estimate year

- **2B. Components of population change**

**2B-1. Resident deaths to population age 65 and older -** We use death data tabulated by the most recent residence of the decedent, not by the place where the death occurred.

**2B-2. Net internal migration for population age 65 and older -** We estimate the net internal migration within the United States during the estimate interval. Our estimate includes household migration derived from Medicare enrollment records and the change in the group quarters population.

> **2B-2a. Migration from Medicare Enrollment -** We use the tabulations of the number of Medicare enrollees in each county obtained from the Centers for Medicare and Medicaid Service (CMS) to calculate the net internal migration rate. Comparable to IRS data used for the population under age 65, Medicare enrollment data allow us to develop a separate estimate of internal migration for the population age 65 and older.

> **Part 1. Internal Migration Rate -** We derive a net internal migration rate (NiMR65+) for the household population age 65 and older for each county, which is based on the difference between the in-migration and out-migration of Medicare enrollees using the following formula:

$$\text{NiMR65+} = (\text{MED}_X * \text{MEDCOV}) - ((\text{MED}_{X-1} * \text{MEDCOV}) + \text{EX64}_x + \text{AF65+}_X + \text{NMPR65+}_X - \text{EMIG65+}_X - \text{PD65+}_X) / \text{MED}_{X-1} * \text{MEDCOV}$$

Where:

NiMR65+   is the county net internal migration rate for the household population age 65 and older

MED   is the county number of Medicare enrollees

EX64   is the county population age 64 in the estimate year (who will turn age 65 in the current estimate year)

AF65+   is the county net Armed Forces movement to/from overseas age 65 and older

NMPR65+   is the county net movement to/from Puerto Rico age 65 and older

EMIG65+   is the county native emigration of the population age 65 and older

PD65+   is the county-level period deaths to the population age 65 and older

MEDCOV   is the Medicare coverage rate which is calculated using the following formula:

$$\text{MEDCOV} = \text{MED}_{2000} / \text{POP65+}_{C2000} * \text{COVUPDATE}$$

Where:

MED   is the county number of Medicare enrollees

POP65+   is the county population age 65 and older

COVUPDATE   is a national level ratio of Medicare coverage in the estimate year to Medicare coverage in the last census year

**Part 2. Net internal migration -** Net migration for the population age 65 and older is the product of the sum of the internal migration base population age 65 and older (OBASE65+) and the net internal migration rate (NiMR65+) minus the sum of the Armed Forces movement to/from overseas (AF65+), the net movement from Puerto Rico (NMPR65+) and the native emigration (EMIG65+).

$$MIG65+_x = (OBASE65+_x * NiMR65+_x) - (AF65+_x + NMPR65+_x - EMIG65+_x)$$

Where:

MIG65+   is the county internal migration of the household population age 65 and older

OBASE65+   is the county population base of potential internal migrants age 65 and older

NiMR65+   is the county net internal migration rate for the household population age 65 and older

AF65+   is the county net Armed Forces movement to/from overseas age 65 and older

NMPR65+   is the county net movement to/from Puerto Rico age 65 and older

EMIG65+   is the county native emigration of the population age 65 and older

Note: In the above formulas -

x   denotes the current estimate year

x-1   denotes the previous estimate year

C2000   denotes a Census 2000 reference date

2000   denotes a calendar year 2000 reference date

If the net migration (MIG65+) is preceded by a minus sign (-), then the figure indicates net out-migration; otherwise, the figure represents net in-migration.

**2B-2b. Migration from Change in Group quarters Population -** The process we use to derive the group quarters change for the population age 65 and older is similar to that used for the population under age 65. See section 1B-3 for a more detailed description.

**2B-3. Net international migration for population age 65 and older -** The process we use to derive the international migration for the population age 65 and older is similar to that used for the population under age 65. See section 1B-4 for a more detailed description.

- **2C. Calculating the Population Age 65 and Older**

The formula for estimating the county population age 65 and older from the base population and the components of population change is as follows:

$$O65_x = O65HP_{x-1} - PD65+_x + MIG65+_x + GQ65+_x + FBINAT65+_x - EMIG65+_x + NMPR65+_x + AF65+_x$$

Where:

| | |
|---|---|
| O65 | is the total county population age 65 and older |
| O65HP | is the county base household population age 65 and older |
| PD65+ | is the county-level period deaths for the population age 65 and older |
| MIG65+ | is the county internal migration of the household population age 65 and older |
| GQ65+ | is the county group quarters population age 65 and older |
| FBINAT65+ | is the county net foreign-born international migration of the population age 65 and older |
| EMIG65+ | is the county native emigration of the population age 65 and older |
| NMPR65+ | is the county net movement to/from Puerto Rico age 65 and older |
| AF65+ | is the county net Armed Forces movement to/from overseas age 65 and older |

Note: In the above formula -

| | |
|---|---|
| X | denotes the current estimate year |
| x-1 | denotes the previous estimate year |

Note: All components of population change are rounded to the nearest whole number. Where applicable, the differences between the sum of rounded components and the independently produced national components are added to or subtracted from the components for Los Angeles County, California (county with the greatest population in the U.S.).

**STEP 3: CALCULATING THE TOTAL POPULATION**

- **3A. Raking the populations**

Raking with a factor is used to ensure consistency between county population estimates and independent estimates of the national population.

**3A-1. Raking the population under age 65 -** The factor is the national estimate of the total population under age 65 divided by the sum of the estimated total

population under age 65 for all counties in the nation. This factor is multiplied by each county population under age 65.

**3A-2. Raking the population age 65 and older -** The factor is the national estimate of the total population aged 65 and older divided by the sum of the estimated total population aged 65 and older for all counties in the nation. This factor is multiplied by each county population age 65 and older.

- **3B. Rounding the populations**

  After applying the factors to the populations under age 65 and age 65 and older, we may have population estimates with fractional results. To eliminate "fractional people," we round the population estimate to the nearest whole number. Where applicable, the differences between the sum of rounded population estimates and the independently produced national population estimates are added to or subtracted from the population for Los Angeles County, California (county with the greatest population in the United States).

- **3C. Administrative components of population change (ACOC)**

  These changes include results of challenges to population estimates, special censuses, test censuses, and dress rehearsal censuses.

- **3D. Calculating the Total Population**

  The total population for each county is the sum of the raked population under age 65 and the raked population age 65 and older. And again, the total population for each state is the sum of the county populations in that state.

**SPECIAL SECTION: ESTIMATING THE THREE-MONTH PERIOD**

The estimated change in population for the three-month period between April 1 and July 1 of the decennial census year is produced using the same method as above, but incorporates three-months of data instead of a full year of data. The three months of data are derived by taking one-quarter of the data for the period July 1, 1999 to June 30, 2000. The only exceptions to this approach are (1) the group quarters population - for which we assume no change in the April 1 group quarters population and it is held constant until July 1, and (2) Armed Forces movement to/from overseas data - for which we use the monthly data for April 1, 2000 to July 1, 2000.